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Planning, Programs and Project Management Division
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Jamie Bernard-Drakey
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Dear Ms. Bernard-Drakey,

Enclosed for submission is a copy of the Final Work Plan (B07KS0198) for the Former Forbes Air Force Base Remedial Action-Operation and Long Term Management, Topeka, Kansas dated June 2018.

If you have any questions, please feel free to contact me at 816-389-3239 or by email at jonathan.harrington@usace.army.mil.

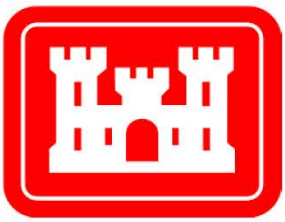
Respectfully,

Jonathan Harrington
Project Manager, Environmental Programs Branch
Kansas City District

Enclosures (1)
Jamie Bernard-Drakey, EPA Region VII (CD only)
USACE Project File

1200C PERM

Final
Landfill Maintenance and Inspection Program and Long-Term Monitoring Work Plan Former Forbes Air Force Base Landfills Vicinity Groundwater Remedial Action-Operation Topeka, Kansas



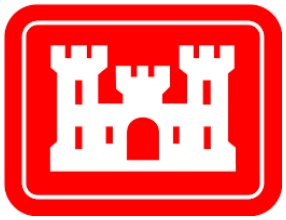
U.S. Army Corps of Engineers
Kansas City District

Contract Number: W912DQ-13-D-3015
Task Order: 0002

June 2018

Final
Landfill Maintenance and Inspection Program and Long-Term Monitoring Work Plan Former Forbes Air Force Base Landfills Vicinity Groundwater Remedial Action-Operation Topeka, Kansas

prepared for



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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
AFB	Air Force Base
COC	chain-of-custody
DD	*Final Decision Document, Former Forbes Air Force Base Landfill Areas of Concern, Topeka, Shawnee County, Kansas*
DQCR	Daily Quality Control Report
DoD	United States Department of Defense
ERB	equipment rinsate blank
FUDS	Formerly Used Defense Sites
IDW	investigative derived waste
KDHE	Kansas Department of Health and Environment
LTM	long-term monitoring
MEE	methane, ethane, ethene
MNA	Monitored Natural Attenuation
MS	matrix spike
MSD	matrix spike duplicate
MTAA	Metropolitan Topeka Airport Authority
NLF	North Landfill
NTU	Nephelometric Turbidity Unit
PDB	passive diffusion bag
QC	quality control
QCSR	Quality Control Summary Report
RA-O	Remedial Action-Operation
RGs	remedial goals
Site	former Forbes Air Force Base
SLF	South Landfill
QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
VOC	volatile organic compound
Work Plan	Landfill Maintenance and Inspection Program and LTM Work Plan

* * * * *

1.0 INTRODUCTION

This Landfill Maintenance and Inspection Program and Long-Term Monitoring (LTM) Work Plan (Work Plan) has been prepared under United States Army Corps of Engineers (USACE) - Kansas City District Contract Number W912DQ-13-D-3015, Task Order No, 0002 for conducting up to five years (base period plus four optional periods) of Groundwater Remedial Action-Operation (RA-O) activities for the North Landfill (NLF) and South Landfill (SLF) at the former Forbes Air Force Base (AFB) (Site) located near Topeka, Kansas (see Figures 1-1 and 1-2). This project is part of the Formerly Used Defense Sites (FUDS) Program administered by USACE on behalf of the Department of Defense (DoD).

1.1 Purpose and Objectives

This Work Plan describes the groundwater RA-O activities to be performed at the NLF and SLF. This Work Plan presents the approach for landfill maintenance and inspection and groundwater data collection and analysis. Data collected will assist in the determination of the effectiveness of the selected remedy, or if additional action is necessary.

The objective of this project is to provide services in support of the *Final Decision Document, Former Forbes Air Force Base Landfill Areas of Concern, Topeka, Shawnee County, Kansas* (USACE, 2014) (DD) which includes landfill maintenance and inspections and groundwater monitoring. The remedial action objectives as stated in the DD are:

- Minimize direct human exposure to landfill waste materials;
- Minimize the amount of landfill leachate reaching the groundwater; and
- Reduce risk to human health from potable use of groundwater containing contaminants of concern above remediation goals (RGs).

The selected remedy as identified in the DD was debris removal, dermal cover for the SLF, municipal solid waste cover for the NLF with an LTM/monitored natural attenuation (MNA) groundwater component.

1.2 Regulatory Framework

This Work Plan is for implementation of the following components of the selected remedy:

- NLF operations and maintenance;
- SLF operations and maintenance; and
- LTM/MNA monitoring, sampling, and data analysis of the groundwater contamination

The selected remedy meets the requirements for remedial actions set forth in the Comprehensive

Environmental Response, Compensation, and Liability Act Section 121, 42 USC Section 9621, because: 1) it is protective of human health and the environment; 2) it meets a level or standard of control of the hazardous substances, pollutants or contaminants, which at least attains the legally applicable or relevant and appropriate requirements under Federal and State laws; 3) it is cost-effective; and, 4) it utilizes permanent solutions and technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances, pollutants or contaminants remaining above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. As long as wastes remain that preclude unrestricted use, the requirement for five-year reviews will remain.

Kansas Department of Health and Environment (KDHE) will provide regulatory oversight for the groundwater RA-O activities.

1.3 Work Plan Organization

This Work Plan is organized as follows:

- Section 1.0 Introduction
- Section 2.0 Site Background
- Section 3.0 Landfill Maintenance and Inspections and Long-Term Monitoring
- Section 4.0 Reporting
- Section 5.0 References
- Tables
- Figures
- Appendices

In addition, the following project-specific plans have been prepared to support the execution of project activities:

- *Uniform Federal Policy Quality Assurance Project Plan, Former Forbes Air Force Base, Landfills Vicinity Groundwater Remedial Action – Operation, Topeka, Kansas* (USACE, 2018) (QAPP)
- *Accident Prevention Plan, Former Forbes Air Force Base, Landfills Vicinity Groundwater Remedial Action – Operation, Topeka, Kansas* (USACE, 2017)

* * * * *

2.0 SITE BACKGROUND

2.1 Site History

The former Forbes AFB, now the Topeka Regional Airport, was an Air Force facility which at times housed reconnaissance and bombardment wings. The Site is in Shawnee County, approximately 2 miles south of the City of Topeka, Kansas. The property is currently owned and operated by the Metropolitan Topeka Airport Authority (MTAA) as a joint municipal/national guard airport and industrial park. Adjacent properties are used for commercial, residential, and agricultural purposes.

The Site was first utilized by the DoD in 1942. Originally named Topeka Army Air Field, the installation was used for training heavy bombardment crews during World War II. The base was inactivated in 1947 but was reactivated in 1948 as Topeka AFB. The new mission included conducting reconnaissance and geodetic work.

The name of the base was changed to Forbes AFB in 1949, after Major Daniel H. Forbes, Jr. Later that year, the base was again deactivated. The base was reactivated in February 1951 during the Korean War. In 1952, the base and facilities were developed and modified to support the Strategic Air Command reconnaissance wing operations, which were replaced by a bombardment wing in 1960. In July 1965, command of Forbes AFB was transferred to the Tactical Air Command. The DoD closed the Forbes AFB in 1973. In January 1974, the MTAA was created by the Topeka City Charter Ordinance to oversee the transition of the property to civilian use. After a 3-year transition period, the title for most of the facility was transferred to the City of Topeka in April of 1976, and the name was changed to Forbes Field.

During active DoD operations, the base utilized and managed two landfills, Landfills No. 1 and No. 2, which are referred to as the SLF and NLF, respectively. They are located on the east side of the Site. The landfills are known to have accepted waste generated on the Site including demolition debris until around 1973, when the base was closed. However, historic records are not available documenting the types of wastes disposed in the landfills or the limits of the waste disposal. These landfills are classified as "dumps" by the KDHE as they were old disposal sites with no known lining and no engineered cover required. The MTAA has construction/demolition landfills that are located south of both the NLF and SLF. These landfills are closed and are not part of the selected remedy addressed by this project.

2.1.1 Current Use

The current land use in the vicinity of both landfills is primarily agricultural and residential. The Topeka Police Department has a shooting range north of the NLF, and the Shawnee County Sheriff Department has a shooting range at Forbes Field approximately 0.75 miles southwest of the SLF. These land uses are not expected to change in the foreseeable future. The town of Berryton, with population of approximately 2,850 people, is approximately 0.5 mile southeast of the SLF. The town of Pauline, with an estimated population of 5,300, is located approximately 1.75 miles northwest of the NLF.

Off-site residences east of the NLF currently use groundwater for drinking/household water, with one residence directly impacted by volatile organic compound (VOC) contamination. This residence is not currently occupied. USACE will provide an alternate water supply at occupied residences that are/or potentially will become impacted by contamination originating from the Site. A newly installed rural water district water supply line is expected to be extended south along California Avenue allowing for the connection of two residences to the rural water supply.

2.1.2 Environmental Investigations and Remedial Activities

Environmental investigations were initiated by USACE in 1994, and included a Site Investigation and several phases of Remedial Investigation work. VOCs were detected in soil gas samples collected during the Site Investigation from within the landfill boundary. This coupled with areas of stressed vegetation within the landfill boundary, and groundwater contamination proximate to the landfill were indicators that waste placed in the landfill may be contributing to the contamination of groundwater at the Site. Soil samples collected from within the NLF and SLF neither indicated a widespread impact across the landfill nor resulted in identification of a source area for VOCs.

In addition to groundwater sampling during the performance of the Remedial Investigation, periodic groundwater monitoring of wells at and downgradient of both landfills was also performed. The results of the investigations and groundwater monitoring programs indicated that VOC contaminants, generally trichloroethene and its daughter products (cis-1,2-dichloroethene [cis-1,2-DCE] and vinyl chloride [VC]), are present in groundwater above RGs near both the NLF and SLF. Four monitoring wells and one residential well, east of the NLF, have detections of VOCs above RGs. Two monitoring wells near the SLF have also had VOC detections above RGs. Based on the detection of contaminants in a residential well and monitoring wells east of the NLF, bottled water and/or granular activated carbon systems were provided to two residences impacted or potentially impacted by the contamination migrating from the NLF.

The Remedial Investigation was followed by a Feasibility Study, as well as a Proposed Plan. A Final DD was signed in 2014. Elements of the selected remedy presented in the DD included the following:

- Installation of a dermal cover consisting of a foundation layer and a vegetated topsoil layer over the buried waste at the SLF;
- Installation of a municipal solid waste cover consisting of a foundation layer, a low permeability layer, a protection layer, and a vegetated topsoil layer at the NLF; and
- Implementation of a LTM/MNA program to provide regular sampling, analyses, and data evaluation of the groundwater at both the NLF and SLF.

The selected remedy in the DD would reduce the potential for exposure to landfill waste and/or groundwater that contains contaminants present above acceptable risk levels. USACE anticipated that remediation of the landfills would minimize the migration of contaminants to groundwater by reducing surface water infiltration and percolation through the landfill. Analytical data and the presence of trichloroethene degradation products indicates that biotic and/or abiotic destructive mechanisms are active in the Site groundwater aquifer, and that the footprint of the contaminants does not appear to be increasing.

Construction of the landfill covers was completed in 2016.

* * * * *

3.0 LANDFILL MAINTENANCE AND INSPECTIONS AND LONG-TERM MONITORING

This section describes the field-related activities to be performed including:

- Landfill maintenance and inspection activities for performance and monitoring of the landfill covers;
- Site inspection activities to document conditions and land use of the Site and adjacent properties; and
- LTM activities (including monitoring well inspection and maintenance, groundwater sampling, well abandonment where applicable, and investigative derived waste [IDW] management) associated with evaluating groundwater conditions.

The field-related activities described in this section will be performed over a period of five years. Table 3-1 presents the schedule of the activities to be performed.

3.1 Utility Clearance

Prior to any field work involving intrusive activities, utility clearance will be required. Utilities will be located with the aid of state-mandated utility location services and/or private utility location services. Utility locates will be conducted in accordance with *Standard Operating Procedure (SOP) 501 Utility Clearance* (included in the QAPP).

3.2 Landfill Maintenance and Inspections

3.2.1 Routine Inspections

Inspections of the NLF and SLF will be performed on a semi-annual basis during the first year and annually thereafter, unless observed conditions indicate that more frequent inspections are necessary. The purpose of the inspections is to monitor the conditions of the landfill covers and identify any maintenance needs. The inspections will be performed after the landfill maintenance (mowing) has been performed (see Section 3.2.3). Components to be inspected during the inspection will generally include:

- Condition of landfill access, including:
  - Access gates and locks and
  - Access roads;
- Cover erosion and displacement, identifying areas of:
  - Standing water,

  - Surface depressions,
  - Cracks or rills,
  - other indicators of settlement, subsidence, or erosion,
  - Animal burrows,
  - Deformation of landfill cap edges,
  - Seep or wet spots, and
  - Orphan waste exposure;
- Condition of vegetation components, including:
  - Establishment and condition of vegetative cover and
  - Identification of invasive trees, plants, or other undesirable vegetation species;
- Condition of landfill drainage features, including inspection of the NLF rock toe drain for clogging or exposure of geosynthetic materials;
- Disturbance, unauthorized access, development, or use that is inconsistent with the remedy; and
- Any indication that the remedy is not protective of public safety or the environment.

A Landfill Inspection and Maintenance Form will be completed for each inspection and photographs will be taken to document inspection findings. A copy of the Landfill Inspection and Maintenance Form is included in the QAPP.

3.2.2 Major Storm Event Inspections

A landfill inspection will also be performed following a major storm event or tornado activity at the Site. A major storm event is defined as a precipitation event with greater than 4 inches of precipitation in 24 hours as reported at the National Weather Service Topeka, Forbes Field weather station. A combination of weather/rainfall alert application(s) and manual verification using the National Weather Service data will be used to determine if a major storm event or tornado activity occurred at the Site. The inspection will take place within 72 hours of the storm event. In the event the contractor is unable to perform the inspection within 72 hours, the USACE Project Manager will be notified and USACE will perform the inspection. The USACE will then provide information regarding conditions observed to the contractor in case minor maintenance and repair work needs to be performed. The major storm event inspections will have the same inspection components and documentation requirements as the routine inspections. A Landfill Inspection and Maintenance Form will be completed for each inspection and photographs will be taken to document inspection findings. A copy of the Landfill Inspection and Maintenance Form is included in the QAPP.

3.2.3 Landfill Maintenance

Landfill maintenance activities will generally include mowing, nutrient application, and minor repairs of the cover system. Five mowing events and one annual nutrient application event are anticipated per year. Minor maintenance and repair of damaged areas will be conducted as needed following identification of such conditions. Minor maintenance and repair activities may include infilling erosional and settlement features, reseeding, removal of undesirable vegetation, backfilling animal burrows and holes, and rock replacement for the rock toe drain and drainage areas. If conditions are observed that will require corrective action beyond minor maintenance and repair or that will require engineering support, the areas will be addressed following consultation with the USACE project team.

3.3 Site Inspection

An annual site inspection will be performed to document conditions and land use of the Site and adjacent properties since there are no land or groundwater use controls being implemented at the Site. The annual site inspection will include the following information:

- Site name, location, and date of inspection;
- Documentation of any changes in Site conditions from the previous inspection;
- Description of current land-use conditions in the immediate vicinity;
- Description of any land disturbance in the immediate vicinity;
- Description of any activity that appears to be inconsistent with the remedial action objectives or other action that may pose a new risk to humans or the environment;
- Review of current property owners; and
- Review of the Kansas Geological Survey Water Well Completion Records Database for any new drinking water wells installed in the vicinity of the Site.

A copy of the Site Inspection Form is included in the QAPP.

3.4 Long-Term Monitoring

LTM activities including monitoring well inspection and maintenance, groundwater sampling, well abandonment where applicable, and IDW management, will be conducted to evaluate groundwater conditions.

Monitoring well sampling will be performed semi-annually during Year 1 and Year 2 using low-flow purging and sampling methodology. Monitoring well sampling will be performed annually during Years 3, 4, and 5 using a combination of low-flow purging and sampling methodologies and no-purge, passive

sampling methodologies using passive diffusion bags (PDBs). Semi-annual sampling will be performed during late spring or early summer and late fall or early winter during Years 1 and 2 to capture seasonal differences. Sampling during Years 3, 4, and 5 will be performed annually during the late spring season or early summer, which is typically the wettest time of the year. One private well, PVW-MJR-1, will also be sampled during each groundwater sampling event. Table 3-2 presents a sampling summary for each sampling event. Well locations for the NLF and SLF are shown on Figures 3-1 and 3-2, respectively.

3.4.1 Monitoring Well Inspection and Maintenance

Monitoring well inspections will be performed annually during well sampling events to assess well condition and identify maintenance needs. Items to be inspected will include:

- Condition of the well completion components including well pad, protective well casing, bollards, lock, and label;
- Condition of the well components including, conditions of the polyvinyl chloride casing and well cap;
- Ground conditions including presence of excessive vegetation, presences of erosional features or the indication of ponding of water near the well; and
- Determination of well screen occlusion.

If monitoring well conditions observed during inspections are such that sample integrity may be compromised, sampling of the monitoring well will be postponed until the conditions are corrected. Monitoring wells with greater than 10% screen occlusion, as determined by comparison of the constructed total depth of the monitoring well to the measured total depth of the monitoring well, will require redevelopment. Monitoring wells that do not stabilize below 50 Nephelometric Turbidity Units (NTUs) during low-flow purging may also be considered for redevelopment. Well development will be conducted in accordance with *Standard Operating Procedure (SOP) 551 Installation and Development of Monitoring Wells and Piezometers* (included in the QAPP). Copies of the Well Development Form are included in the QAPP. Minor to moderate maintenance items, such as painting and well redevelopment, that can readily be addressed at the time of the inspection may be performed at that time. Maintenance items requiring additional resources may be addressed during the next scheduled site activities, or during a separate mobilization, depending on the resource required and the urgency of the maintenance item. Findings of the well inspection will be documented on the Monitoring Well Inspection and Maintenance Form. A copy of the Monitoring Well and Inspection and Maintenance Form is included in the QAPP.

USACE has identified Monitoring Well OW-MSR-08 at the NLF for installation of a new flush-mount protective casing, lid, and replacement concrete pad. These maintenance activities will be performed during Year 1 by a Kansas-licensed driller and will be overseen by the Field Site Manager (FSM). The protective casing and concrete well pad at Monitoring Well OW-MSR-08 will be removed with mechanical equipment or tools in such a way as to not cause damage to the well PVC casing. The well riser will remain sealed during the pad/protective casing removal to prevent foreign material from entering into the monitoring well. Upon removal of the protective casing and concrete well pad, a new concrete well pad will be installed with similar dimensions as the previous well pad. A new flush-mount protective casing with bolt on lid will be set in the concrete well pad.

3.4.2 Fluid Levels and Total Depth Measurements

Prior to sample collection during each sampling event, a synoptic round of fluid levels and total depth measurements will be collected from each Site monitoring well (see Table 3-2) within a 24-hour period. Measurements will be collected from the top of casing reference point to the nearest 0.01-foot. Total depth measurements will be compared to the well construction details to determine if monitoring well redevelopment is required as described in Section 3.4.1. If the total depth measurement collected during a sampling round compared to the constructed total depth of the monitoring indicates greater than 10% screen occlusion, then well redevelopment will be required. Fluid level and total depth measurements will be collected in accordance with *SOP 511 Fluid Level and Total Depth Measurements* (included in the QAPP). A copy of the Fluid Level and Total Depth Measurements Form is included in the QAPP.

3.4.3 Monitoring Well Purging and Sample Collection

Groundwater sampling will be performed using multiple methods during the project. Monitoring well samples will be collected using low-flow purging and sampling methodologies for the first four sampling events (semi-annual sampling for Years 1 and 2). After the first two years, sampling will be performed using a combination of low-flow purging and sampling methodologies and no-purge sampling methodologies using PDBs (annual sampling for Years 3, 4, and 5). Table 3-2 presents the monitoring wells to be sampled for each event, including the field parameters and laboratory analysis. Details of the laboratory analytical methods (including limits of quantitation, limit of detection, and detection limit, and quality control [QC] parameters) are included in the QAPP.

3.4.3.1 Low-Flow Purging and Sampling

Low-flow purging and sampling with a non-dedicated bladder pump will be used for collection of field water quality measurements and groundwater samples for laboratory analysis (see Table 3-2). Monitoring

wells will be sampled sequentially from the least-impacted to most-impacted at each landfill to limit to possibility of cross-contamination. Field measurements to be collected include: temperature, pH, conductivity, oxidation-reduction potential, dissolved oxygen, turbidity, and ferrous iron. Samples will be collected for laboratory analysis of VOCs, methane, ethane, ethene (MEE), total organic carbon, and inorganic analyses including nitrate, nitrite, sulfate, sulfide, alkalinity as carbonate, and carbon dioxide. Analytical methods are included in Worksheet #12 of the QAPP. Low-flow purging and sampling will be conducted in accordance with the USACE – Kansas City District *Standard Operating Procedure for Groundwater Low-Flow Purging* (included in the QAPP). Calibration of field instruments and meters used for collection of field measurements will be conducted in accordance with the manufacturer's standard calibration procedures. Copies of the Groundwater Sampling Form and Field Instrument Calibration Form are included in the QAPP.

3.4.3.2 Passive Diffusion Bag Placement and Sampling

PDBs will be used for collection of VOC and MEE groundwater samples for laboratory analysis from select monitoring wells (see Table 3-2). PDBs will be placed in the monitoring wells at least one month prior to the sampling event but not more than three months to allow for equilibration and limit deterioration. Pre-filled PDBs will be placed in the monitoring wells using pre-constructed monitoring well-specific tether assemblies for consistent PDB placement each event. PDB placement and sampling will be conducted in accordance with *SOP 205 Collection of Groundwater Samples Using Passive Diffusion Bags* (included in the QAPP). Copies of the PDB Deployment Form and PDB Sampling Form are included in the QAPP.

3.4.4 Private Well Sample Collection

Groundwater samples for VOC analysis will be collected from one private well during each sampling event. The sample will be collected in accordance with *SOP 209 Collection of Groundwater Samples from Water Wells* (included in the QAPP).

3.4.5 Quality Control Samples

QC samples will be collected at the same time and analyzed for the same set of parameters as the original sample. Samples will consist of field duplicates, matrix spike (MS) / matrix spike duplicates (MSDs), trip blanks, equipment rinsate blanks (ERBs), and PDB blanks. Field duplicate samples will be collected at a frequency of 10% (1 in 10) and MS/MSD samples will be collected at a frequency of 5% (1 in 20). At a minimum, one duplicate and one MS/MSD will be collected during each sampling event. A trip blank for VOC analysis will be included in each cooler containing VOC samples. One ERB will be collected from

the non-dedicated bladder pump during each sampling event. One PDB blank will be collected from the water used in the pre-filled PDBs during each sampling event. QC samples will be collected in accordance with *the Standard Operating Procedure for Groundwater Low-Flow Purging* (included in the QAPP) and *SOP 205 Collection of Groundwater Samples Using Passive Diffusion Bags* (included in the QAPP).

3.4.6 Sample Custody and Shipping

From the time of collection, samples will be handled under chain-of-custody (COC) protocol to maintain integrity of the samples. Samples collected for laboratory analysis will be packed and shipped in a way to maintain QC and limit breakage of sample containers. Samples will require placement in coolers with an appropriate amount of ice to maintain an internal temperature of 4 ± 2 degrees Celsius during custody and shipping from the field to the lab. COC documentation will be included inside of the cooler. Samples will be sent to the laboratory via overnight shipment (i.e. FedEx) or a laboratory courier. If sent via FedEx, a FedEx air bill will be filled out and the cooler(s) will be delivered directly to a FedEx agent or to an authorized agent for shipment. The shipment tracking number will be recorded in the field logbook. If sent via laboratory courier, the courier will sign the COC upon receipt of the packed samples. Sample packaging and shipping will be performed in accordance with *SOP 592 Sample Packing and Shipping* (included in the QAPP).

3.4.7 Well Abandonment

One private residential private well (PVW-MSR-1) (Figure 3-1), two monitoring wells (SLF-OW-04 and SLF-OW-18) (Figure 3-2), and one piezometer (associated with the NLF) (Figure 3-1), will be abandoned during Year 1 by a Kansas-licensed driller and will be overseen by the FSM. Abandonment procedures will follow the Kansas Administrative Regulations Agency 28 Article 30 Section 7. A copy of the Water Well Record Form WWC-5 for private well PVW-MSR-1 and well construction details for the NLF and SLF monitoring wells are included in Appendix A.

Prior to abandonment of PVW-MSR-1, the standing water in the well will be pumped out and the pump assembly, pit less adaptor, drop pipe, and cable and electrical line, will be removed. Once the pump assembly is removed, the water line from the well to the residence will be capped and sealed. A water level and total depth measurement will be recorded. An attempt will be made to pull the well casing prior to grouting. If the well cannot be pulled, the well will be over-drilled. After well abandonment, the granular activated carbon unit and associated piping and fixtures will be disconnected and removed from the residence and properly disposed.

Abandonment of the two monitoring wells (SLF-OW-04 and SLF-OW-18), and one piezometer (associated with the NLF), will include water level and total depth measurement, removing the surface completion, pulling the casing and placing a grout seal within the resulting borehole.

Photographs of each well location will be taken to document pre- and post-work conditions. Each well location will be restored to its original condition after well/piezometer abandonment. This will include removal and disposal of materials associated with the abandonment; repair of any ruts made during abandonment activities; and backfilling, grading, and seeding the locations to match surrounding areas.

A Water Well Plugging Record Form WWC-5P will be submitted to the KDHE Bureau of Water for each well/piezometer upon completion of abandonment activities. Well abandonment activities will be documented on a Well Abandonment Form. A copy of the Well Abandonment Form is included in the QAPP. Well abandonment will be performed in accordance with *SOP 553 Abandonment of Monitoring Wells and Piezometers* (included in the QAPP).

3.4.8 Decontamination

All non-disposable and non-dedicated equipment which contact the sample will be decontaminated prior to the collection of each sample. Decontamination of equipment will be conducted in accordance with *SOP 504 Decontamination* (included in the QAPP).

3.4.9 IDW

LTM sampling activities are anticipated to generate solid waste including PPE, equipment packaging, and used sampling supplies and liquid waste including purge water, decontamination water, and rinse water. Well abandonment activities are anticipated to generate solid waste including well construction materials, piping, water well equipment, water treatment equipment, soil if over-drilling is required, and liquid waste including well water and water removed from water well and treatment equipment.

Solid waste generated during sampling and well abandonment activities will be disposed as nonhazardous waste. Liquid waste generated during sampling and well abandonment activities will be temporarily stored in United States Department of Transportation-approved containers and staged in a designated area on site pending disposal based on laboratory analytical results. It is anticipated that liquid waste generated will be able to be disposed of as nonhazardous waste.

IDW will be containerized and managed in accordance with *SOP 601 Investigative Derived Waste Storage, Sampling, and Disposal* (included in the QAPP). A copy of the IDW Tracking Form is included

in the QAPP. The following facilities were identified for potential disposal of waste materials generated during the implementation of the project:

- Fluids generated during the activities will be sent to the US Ecology facility in Tulsa, Oklahoma and
- Nonhazardous solid wastes will be disposed of at Waste Management's Rolling Meadows Landfill near Topeka, Kansas.

3.5 Documentation

Each sample, field measurement, and field activity will be properly documented to facilitate timely, correct, and complete analyses, and support actions concerning the site work. The documentation system will provide a means to identify, track, and monitor individual samples from the point of collection through the final reporting of data. Field documentation will be recorded in accordance with *SOP 701 Field Documentation* (included in the QAPP).

* * * * *

4.0 REPORTING

Reporting of site activities will take place throughout the duration of the project. Contents and frequency of the different reports are described below.

4.1 Daily Quality Control Reports

A Daily Quality Control Report (DQCR) will be submitted for each day of field activities. Field and COC forms will be submitted with the DQCR for each day of sampling. The draft DQCR will be submitted to the USACE Project Manager for review within 24 hours after a work day has been completed. If necessary, comments will be incorporated and a revised DQCR will be submitted within seven business days. A copy of the DQCR form is included in the QAPP.

4.2 Field Work Summary Reports

A Field Activities Summary Report will be submitted following completion of each of the following activities:

- Landfill maintenance and inspection;
- Major storm event inspection; and
- LTM activities including site inspection, monitoring well maintenance and inspections, groundwater sampling, and well abandonment.

The Field Activities Summary Report will include copies of approved DQCRs and copies of field forms.

4.3 Quality Control Summary Reports

A Quality Control Summary Report (QCSR) will be prepared within 60 days after the last data package has been received from the laboratory for each sampling event. The QCSR will include results of data validation, summary tables of analytical data and field parameters, and sample location map.

4.4 Landfill Maintenance and Inspection Program and Long-Term Monitoring Report

An annual RA-O LTM report will be prepared following completion of the landfill inspections and maintenance, site inspections, well inspections and maintenance, groundwater sampling, and well abandonment. Analytical data will be assessed using one or more but not limited to the following methods: tabulation with comparison to RGs, statistical analysis, concentration trend time series plots, evaluation of groundwater geochemistry, and isoconcentration map(s). The remedial timeframe in relation

to MNA effectiveness will be assessed using statistical analysis and time series data (e.g. estimates of contaminant mass reduction or temporal trends) to estimate attenuation rates. Appropriate evaluation methods will be selected based on historical and newly collected data available at the time of the annual RA-O LTM report preparation. A typical annual RA-O LTM report outline may include the following:

Section 1.0 – This section includes the purpose of the report and LTM/MNA program including RGs and outline of the report.

Section 2.0 – This section presents the history and background information for the Site.

Section 3.0 – This section includes a summary of site activities performed during the reporting period. This may include the following:

- Summary and findings of landfill maintenance and inspection activities;
- Issues encountered and corrective actions taken at the landfills;
- Summary and findings of the site inspection;
- Summary and findings of the monitoring well inspection and maintenance activities;
- LTM program description and methodology;
- Summary of sampling activities;
- Issues encountered and corrective action taken during LTM activities; and
- Waste management activities.

Section 4.0 – This section includes a summary of data obtained during the reporting period. This may include evaluation of groundwater MNA data, trends of contaminants of concern in groundwater, and evaluation of plume stability and the remedial timeframe.

Section 5.0 – This section provides conclusions based on the site activities and data obtained during the reporting period.

Section 6.0 – This section includes references to documents and materials used in the writing of the report.

Tables – Including summaries of field parameters collected and analytical data (including QC data) screened against RGs.

Figures – Including groundwater elevations with flow direction and chemical concentrations in groundwater.

Appendices – The appendices may include photographic logs, copies of field documentation and forms, QCSRs (including laboratory analytical reports), and additional documentation as needed to support report findings.

* * * * *

5.0 REFERENCES

USACE, 2014. *Final Decision Document, Former Forbes Air Force Base Landfill Areas of Concern, Topeka, Shawnee County, Kansas.* May 2014.

USACE, 2017. *Accident Prevention Plan, Former Forbes Air Force Base, Landfills Vicinity Groundwater Remedial Action – Operation, Topeka, Kansas.* 2017.

USACE, 2018. *Uniform Federal Policy Quality Assurance Project Plan, Former Forbes Air Force Base, Landfills Vicinity Groundwater Remedial Action – Operation, Topeka, Kansas*. 2018.

USEPA, 1998. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*. EPA/600/R-98/128. September 1998.

USEPA, 2004. *Performance Monitoring of MNA Remedies for VOCs in Ground Water*. EPA/600/R-04/027. April 2004.

* * * * *

TABLES

Table 3-1
Landfill Maintenance and Inspection and Long-Term Monitoring Schedule, Years 1-5
Former Forbes Air Force Base
Topeka, Kansas

Period	Activity	Schedule
Year 1		
	Landfill Inspection	Semi-annual
	Major Storm Event	As necessary
	Landfill Maintenance	5 mowing events; 1 nutrient application; repairs as needed
	Site Inspection	Annual
	Monitoring Well Inspection and Maintenance	Annual
	Well Sampling	Semi-annual
	Well abandonment	Single event
	Daily Quality Control Report	Daily during field activities
	Field Work Summary Report	Following completion of field activity event
	Quality Control Summary Report	Semi-annual
	LTM Report	Annual
Year 2		
	Landfill Inspection	Annual
	Major Storm Event	As necessary
	Landfill Maintenance	5 mowing events; 1 nutrient application; repairs as needed
	Site Inspection	Annual
	Monitoring Well Inspection and Maintenance	Annual
	Well Sampling	Semi-annual
	Daily Quality Control Report	Daily during field activities
	Field Work Summary Report	Following completion of field activity event
	Quality Control Summary Report	Semi-annual
	LTM Report	Annual
Year 3		
	Landfill Inspection	Annual
	Major Storm Event	As necessary
	Landfill Maintenance	5 mowing events; 1 nutrient application; repairs as needed
	Site Inspection	Annual
	Monitoring Well Inspection and Maintenance	Annual
	Well Sampling	Annual
	Daily Quality Control Report	Daily during field activities
	Field Work Summary Report	Following completion of field activity event
	Quality Control Summary Report	Annual
	LTM Report	Annual

Table 3-1
Landfill Maintenance and Inspection and Long-Term Monitoring Schedule, Years 1-5
Former Forbes Air Force Base
Topeka, Kansas

Period	Activity	Schedule
Year 4		
	Landfill Inspection	Annual
	Major Storm Event	As necessary
	Landfill Maintenance	5 mowing events; 1 nutrient application; repairs as needed
	Site Inspection	Annual
	Monitoring Well Inspection and Maintenance	Annual
	Well Sampling	Annual
	Daily Quality Control Report	Daily during field activities
	Field Work Summary Report	Following completion of field activity event
	Quality Control Summary Report	Annual
	LTM Report	Annual
Year 5		
	Landfill Inspection	Annual
	Major Storm Event	As necessary
	Landfill Maintenance	5 mowing events; 1 nutrient application; repairs as needed
	Site Inspection	Annual
	Monitoring Well Inspection and Maintenance	Annual
	Well Sampling	Annual
	Daily Quality Control Report	Daily during field activities
	Field Work Summary Report	Following completion of field activity event
	Quality Control Summary Report	Annual
	LTM Report	Annual

Table 3-2
Long-Term Monitoring Groundwater Well Sampling Plan
Former Forbes Air Force Base
Topeka, Kansas

Group Name	Sample Point	Sample Designator	Fluid Level Measurements		Sampling Method			Analytical Parameters[1]									Field Measured Parameters							QC Requirements[2,3]		Low-flow Sample Order (by Group)[4]
											Inorganic Analytes													Field Duplicate (10%)	MS/MSD (5%)	
			Water Level	Total Depth	Low-flow	PDB	Grab	VOCs	MEE	TOC	Nitrate	Nitrite	Sulfate	Sulfide	Alkalinity as CO_3	CO_2	Temp	pH	Cond	ORP	DO	Turbidity	Ferrous Iron			
Year 1 First Semiannual Event[5]																										
NLF	OW-05	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			21
	OW-05D	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	OW-06	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			20
	OW-06D	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			8
	OW-07	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			13
	OW-07D	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
	OW-08	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW01X	2
	OW-10	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			12
	OW-11D	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			6
	OW-12	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	OW-13	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	OW-14	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW11		19
	OW-14D	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			7
	OW-MSR-01	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			11
	OW-MSR-02	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			10
	OW-MSR-03	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			9
	OW-MSR-04	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			17
	OW-MSR-05	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW11		22
	OW-MSR-06	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			14
	OW-MSR-07	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			15
	OW-MSR-08	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			16
	OW-MSR-09	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			18
SLF	SLF-OW-01	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW11		6
	SLF-OW-02	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	SLF-OW-03	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	SLF-PZ-04	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW01X	2
	SLF-OW-15	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	SLF-OW-17	GW01	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
Private	PVW-MJR-01	GW01					X	X																		

Notes:

1. Analytical methods are presented on Worksheets #19 and #30 of the Uniform Federal Policy - Quality Assurance Project Plan Former Forbes Air Force Base Landfills Vicinity Groundwater Remedial Action-Operation, Topeka, Kansas.
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   Sample naming for trip blanks will be signified by the document control number from the chain of custody for that cooler followed by a trip blank designator (for example "051518A/TB01" for the trip blank included in Cooler A for samples collected on May 15, 2018).
3. Location of QC samples may be adjusted at time of sampling based on conditions encountered.
4. Sample order initially based on historical data from each landfill. Future sample order of each landfill may be revised based on additional data collected.
5. Year 1 is base contract year. Years 2, 3, 4, and 5 are option contract years.

Cond = specific conductance; DO = dissolved oxygen; MSD = matrix spike duplicate; PDB = passive diffusion bag; TOC = total organic carbon
CO_2 = carbon dioxide; GW = groundwater sample; MEE = methane, ethane, ethene; QC = quality control; VOC = volatile organic compound
CO_3 = carbonate; MS = matrix spike; ORP = oxidation-reduction potential; Temp = temperature

Table 3-2
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Former Forbes Air Force Base
Topeka, Kansas

Group Name	Sample Point	Sample Designator	Fluid Level Measurements		Sampling Method			Analytical Parameters[1]									Field Measured Parameters							QC Requirements[2,3]		Low-flow Sample Order (by Group)[4]
											Inorganic Analytes															
			Water Level	Total Depth	Low-flow	PDB	Grab	VOCs	MEE	TOC	Nitrate	Nitrite	Sulfate	Sulfide	Alkalinity as CO_3	CO_2	Temp	pH	Cond	ORP	DO	Turbidity	Ferrous Iron	Field Duplicate (10%)	MS/MSD (5%)	
Year 1 Second Semiannual Event[5]																										
NLF	OW-05	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			21
	OW-05D	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	OW-06	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			20
	OW-06D	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			8
	OW-07	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			13
	OW-07D	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
	OW-08	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW02X	2
	OW-10	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			12
	OW-11D	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			6
	OW-12	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	OW-13	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	OW-14	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW22		19
	OW-14D	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			7
	OW-MSR-01	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			11
	OW-MSR-02	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			10
	OW-MSR-03	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			9
	OW-MSR-04	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			17
	OW-MSR-05	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW22		22
	OW-MSR-06	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			14
	OW-MSR-07	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			15
	OW-MSR-08	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			16
	OW-MSR-09	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			18
SLF	SLF-OW-01	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW22		6
	SLF-OW-02	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	SLF-OW-03	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	SLF-PZ-04	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW02X	2
	SLF-OW-15	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	SLF-OW-17	GW02	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
Private	PVW-MJR-01	GW02					X	X																		

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3. Location of QC samples may be adjusted at time of sampling based on conditions encountered.
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											Inorganic Analytes															
			Water Level	Total Depth	Low-flow	PDB	Grab	VOCs	MEE	TOC	Nitrate	Nitrite	Sulfate	Sulfide	Alkalinity as CO_3	CO_2	Temp	pH	Cond	ORP	DO	Turbidity	Ferrous Iron	Field Duplicate (10%)	MS/MSD (5%)	
Year 2 First Semiannual Event[5]																										
NLF	OW-05	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			21
	OW-05D	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	OW-06	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			20
	OW-06D	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			8
	OW-07	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			13
	OW-07D	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
	OW-08	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW03X	2
	OW-10	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			12
	OW-11D	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			6
	OW-12	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	OW-13	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	OW-14	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW33		19
	OW-14D	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			7
	OW-MSR-01	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			11
	OW-MSR-02	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			10
	OW-MSR-03	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			9
	OW-MSR-04	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			17
	OW-MSR-05	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW33		22
	OW-MSR-06	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			14
	OW-MSR-07	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			15
	OW-MSR-08	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			16
	OW-MSR-09	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			18
SLF	SLF-OW-01	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW33		6
	SLF-OW-02	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	SLF-OW-03	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	SLF-PZ-04	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW03X	2
	SLF-OW-15	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	SLF-OW-17	GW03	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
Private	PVW-MJR-01	GW03					X	X																		

Notes:

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Table 3-2
Long-Term Monitoring Groundwater Well Sampling Plan
Former Forbes Air Force Base
Topeka, Kansas

Group Name	Sample Point	Sample Designator	Fluid Level Measurements		Sampling Method			Analytical Parameters[1]									Field Measured Parameters							QC Requirements[2,3]		Low-flow Sample Order (by Group)[4]
											Inorganic Analytes															
			Water Level	Total Depth	Low-flow	PDB	Grab	VOCs	MEE	TOC	Nitrate	Nitrite	Sulfate	Sulfide	Alkalinity as CO_3	CO_2	Temp	pH	Cond	ORP	DO	Turbidity	Ferrous Iron	Field Duplicate (10%)	MS/MSD (5%)	
Year 2 Second Semiannual Event[5]																										
NLF	OW-05	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			21
	OW-05D	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	OW-06	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			20
	OW-06D	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			8
	OW-07	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			13
	OW-07D	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
	OW-08	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW04X	2
	OW-10	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			12
	OW-11D	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			6
	OW-12	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	OW-13	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	OW-14	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW44		19
	OW-14D	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			7
	OW-MSR-01	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			11
	OW-MSR-02	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			10
	OW-MSR-03	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			9
	OW-MSR-04	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			17
	OW-MSR-05	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW44		22
	OW-MSR-06	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			14
	OW-MSR-07	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			15
	OW-MSR-08	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			16
	OW-MSR-09	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			18
SLF	SLF-OW-01	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW44		6
	SLF-OW-02	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			5
	SLF-OW-03	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	SLF-PZ-04	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW04X	2
	SLF-OW-15	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
	SLF-OW-17	GW04	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
Private	PVW-MJR-01	GW04					X	X																		

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											Inorganic Analytes													Field Duplicate (10%)	MS/MSD (5%)	
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Year 3 Annual Event[5]																										
NLF	OW-05	GW05	X	X		X		X	X																	
	OW-05D	GW05	X	X		X		X	X																	
	OW-06	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW05X	5
	OW-06D	GW05	X	X		X		X	X																	
	OW-07	GW05	X	X		X		X	X																	
	OW-07D	GW05	X	X		X		X	X																	
	OW-08	GW05	X	X		X		X	X															GW55		
	OW-10	GW05	X	X		X		X	X																	
	OW-11D	GW05	X	X		X		X	X																	
	OW-12	GW05	X	X		X		X	X																	
	OW-13	GW05	X	X		X		X	X																	
	OW-14	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
	OW-14D	GW05	X	X		X		X	X																	
	OW-MSR-01	GW05	X	X		X		X	X																	
	OW-MSR-02	GW05	X	X		X		X	X																	
	OW-MSR-03	GW05	X	X		X		X	X																	
	OW-MSR-04	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			2
	OW-MSR-05	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW55		6
	OW-MSR-06	GW05	X	X		X		X	X																	
	OW-MSR-07	GW05	X	X		X		X	X																	
	OW-MSR-08	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	OW-MSR-09	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
SLF	SLF-OW-01	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			2
	SLF-OW-02	GW05	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	SLF-OW-03	GW05	X	X		X		X	X																	
	SLF-PZ-04	GW05	X	X		X		X	X																GW05X	
	SLF-OW-15	GW05	X	X		X		X	X																	
	SLF-OW-17	GW05	X	X		X		X	X															GW55		
Private	PVW-MJR-01	GW05					X	X																		

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											Inorganic Analytes													Field Duplicate (10%)	MS/MSD (5%)	
			Water Level	Total Depth	Low-flow	PDB	Grab	VOCs	MEE	TOC	Nitrate	Nitrite	Sulfate	Sulfide	Alkalinity as CO_3	CO_2	Temp	pH	Cond	ORP	DO	Turbidity	Ferrous Iron			
Year 4 Annual Event[5]																										
NLF	OW-05	GW06	X	X		X		X	X																	
	OW-05D	GW06	X	X		X		X	X																	
	OW-06	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW06X	5
	OW-06D	GW06	X	X		X		X	X																	
	OW-07	GW06	X	X		X		X	X																	
	OW-07D	GW06	X	X		X		X	X																	
	OW-08	GW06	X	X		X		X	X															GW66		
	OW-10	GW06	X	X		X		X	X																	
	OW-11D	GW06	X	X		X		X	X																	
	OW-12	GW06	X	X		X		X	X																	
	OW-13	GW06	X	X		X		X	X																	
	OW-14	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
	OW-14D	GW06	X	X		X		X	X																	
	OW-MSR-01	GW06	X	X		X		X	X																	
	OW-MSR-02	GW06	X	X		X		X	X																	
	OW-MSR-03	GW06	X	X		X		X	X																	
	OW-MSR-04	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			2
	OW-MSR-05	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW66		6
	OW-MSR-06	GW06	X	X		X		X	X																	
	OW-MSR-07	GW06	X	X		X		X	X																	
	OW-MSR-08	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	OW-MSR-09	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
SLF	SLF-OW-01	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			2
	SLF-OW-02	GW06	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	SLF-OW-03	GW06	X	X		X		X	X																	
	SLF-PZ-04	GW06	X	X		X		X	X																GW06X	
	SLF-OW-15	GW06	X	X		X		X	X																	
	SLF-OW-17	GW06	X	X		X		X	X															GW66		
Private	PVW-MJR-01	GW06					X	X																		

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Year 5 Annual Event[5]																										
NLF	OW-05	GW07	X	X		X		X	X																	
	OW-05D	GW07	X	X		X		X	X																	
	OW-06	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		GW07X	5
	OW-06D	GW07	X	X		X		X	X																	
	OW-07	GW07	X	X		X		X	X																	
	OW-07D	GW07	X	X		X		X	X																	
	OW-08	GW07	X	X		X		X	X															GW77		
	OW-10	GW07	X	X		X		X	X																	
	OW-11D	GW07	X	X		X		X	X																	
	OW-12	GW07	X	X		X		X	X																	
	OW-13	GW07	X	X		X		X	X																	
	OW-14	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
	OW-14D	GW07	X	X		X		X	X																	
	OW-MSR-01	GW07	X	X		X		X	X																	
	OW-MSR-02	GW07	X	X		X		X	X																	
	OW-MSR-03	GW07	X	X		X		X	X																	
	OW-MSR-04	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			2
	OW-MSR-05	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	GW77		6
	OW-MSR-06	GW07	X	X		X		X	X																	
	OW-MSR-07	GW07	X	X		X		X	X																	
	OW-MSR-08	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	OW-MSR-09	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
SLF	SLF-OW-01	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			2
	SLF-OW-02	GW07	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			1
	SLF-OW-03	GW07	X	X		X		X	X																	
	SLF-PZ-04	GW07	X	X		X		X	X																GW07X	
	SLF-OW-15	GW07	X	X		X		X	X																	
	SLF-OW-17	GW07	X	X		X		X	X															GW77		
Private	PVW-MJR-01	GW07					X	X																		

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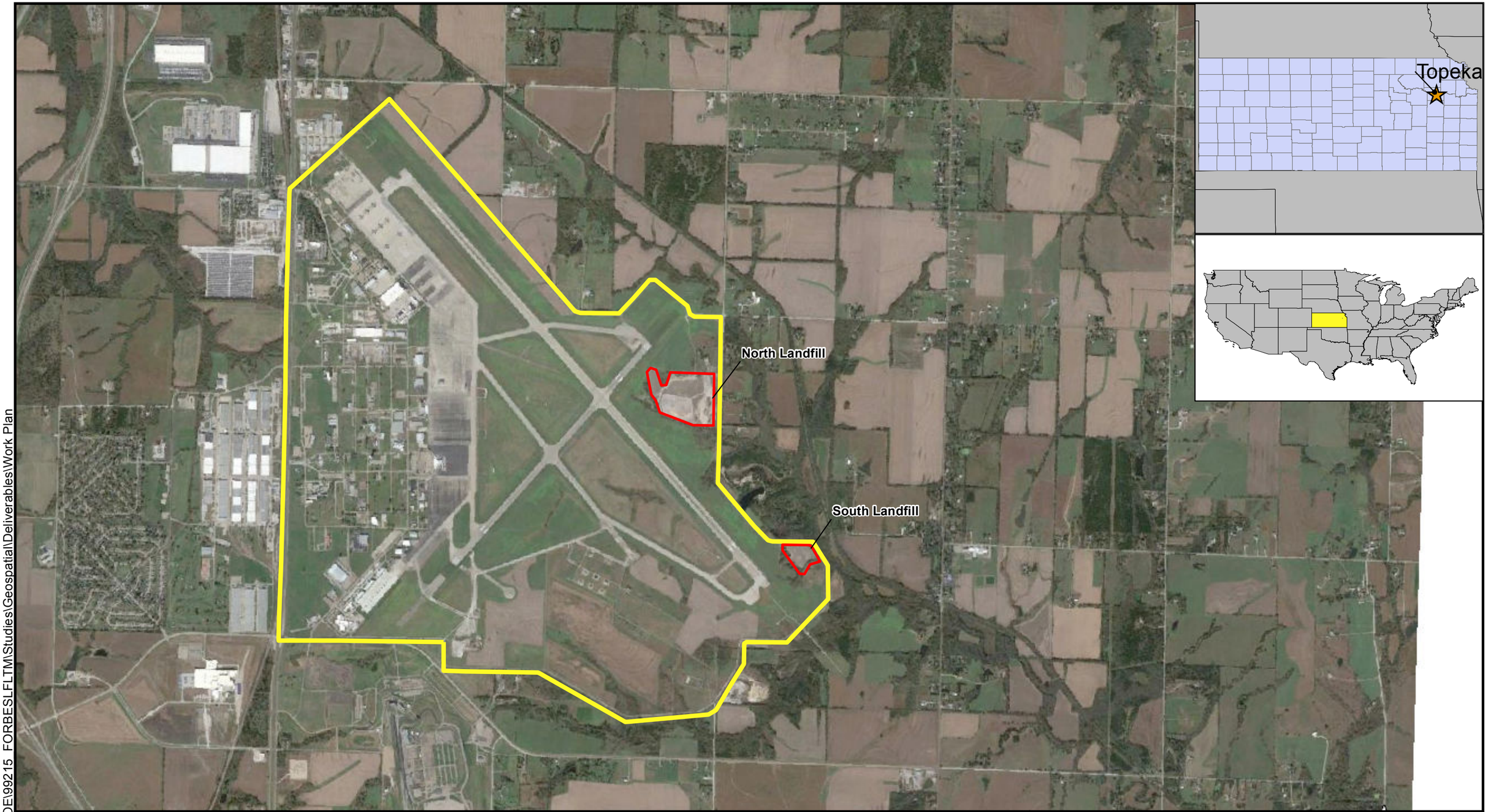
FIGURES



Legend

DoD Landfill Boundary (approximate)

Site Boundary

0 1,125 2,250 4,500

Feet

N

Source: ESRI and Burns & McDonnell Engineering.
2016 imagery: Google Earth

Figure 1-1
Site Location Map
Former Forbes Air Force Base
Landfills Vicinity Groundwater RA-O
Topeka, Kansas

Z:\Clients\ENSUSCOE\99215 FORBESLFLTM\Studies\Geospatial\Deliverables\Work Plan

North Landfill

South Landfill

Legend

Forbes Field Boundary

DoD Landfill Boundary (approximate)

0 250 500 1,000 Feet

N

Source: Google Eath, ESRI, and Burns & McDonnell Engineering.

Figure 1-2
Site Layout
Former Forbes Air Force Base
Landfills Vicinity Groundwater RA-O
Topeka, Kansas

Legend

- Residential Well
- Residential Well and Piezometer Abandoned or to be Abandoned
- Topeka Limestone Well
- Calhoun Shale Well
- Overburden Well
- Streams/Drainage Ways
- DoD Landfill Boundary (Approximate)
- Forbes Field Boundary
- MTAA Landfill

NOTE:

1. OW-07 is the only overburden well.

0 150 300 600 Feet

N

Source: Google Eath, ESRI, and Burns & McDonnell Engineering.

Figure 3-1
North Landfill Site Map
Former Forbes Air Force Base
Landfills Vicinity Groundwater RA-O
Topeka, Kansas

Z:\Clients\ENSUSCOF\99215_FORBESLFLTMStudies\Geospatial\Deliverables\Work Plan

Legend

- Streams/Drainage Ways
- Forbes Field Boundary
- DoD Landfill Boundary (approximate)
- MTAA Landfill
- Severy Shale Well
- Topeka Limestone Well
- Monitoring Well - To Be Abandoned

0 75 150 300 Feet

N

Source: Google Eath, ESRI, and Burns & McDonnell Engineering.

Figure 3-2
South Landfill Site Map
Former Forbes Air Force Base
Landfills Vicinity Groundwater RA-O
Topeka, Kansas

Z:\Clients\ENS\USCOE\99215_FORBESLFLTM\Studies\Geospatial\Deliverables\Work Plan

APPENDIX A – WELL CONSTRUCTION INFORMATION

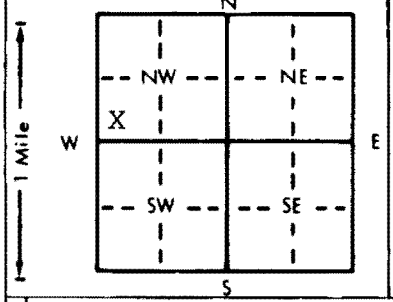
WATER WELL RECORD Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL: County: SHAWNEE | Fraction: SW ¼ SW ¼ NW ¼ | Section Number: 4 | Township Number: T 13 S | Range Number: R 16E E/W

Distance and direction from nearest town or city street address of well if located within city?
2½ south of Topeka

2 WATER WELL OWNER: W.L. Mechler
RR#, St. Address, Box # : 6420 SE California
City, State, ZIP Code : Berryton, KS 66409
Board of Agriculture, Division of Water Resources Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 100' ft. ELEVATION:
Depth(s) Groundwater Encountered 1. 17' ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 10' ft. below land surface measured on mo/day/yr 5-12-95
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield 3 gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 12" in. to ft., and in. to ft.
WELL WATER TO BE USED AS: 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering 10 Monitoring well 11 Injection well 12 Other (Specify below)
Was a chemical/bacteriological sample submitted to Department? Yes No X; If yes, mo/day/yr sample was submitted
Water Well Disinfected? Yes X No

5 TYPE OF BLANK CASING USED: 1 Steel 2 PVC 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)
CASING JOINTS: Glued X Clamped Welded Threaded
Blank casing diameter 5" in. to 0-10 ft., Dia 5" in. to 25-45 ft., Dia 5" in. to 65-95 ft.
Casing height above land surface 24" in., weight 2.82 lbs./ft. Wall thickness or gauge No. .258
TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile 7 PVC 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)
SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 9 Drilled holes 10 Other (specify) 11 None (open hole)
SCREEN-PERFORATED INTERVALS: From 10 ft. to 25 ft., From ft. to ft.
From 45 ft. to 65 ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 95 ft. to 100 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other
Grout Intervals: From 0 ft. to 10 ft., From ft. to ft., From ft. to ft.
What is the nearest source of possible contamination: 1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below)
Direction from well? east How many feet? 200'

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	2	Top Soil			
2	10	Clay-Brown			
10	17	FS-CS-Brown			
17	19	Limestone-Yellow			NOTE: 5-19-95 Permission to
19	25	Limestone-Grey			shallow grout from Rich
25	28	Shale-Grey			Harper.
28	31	Limestone-Grey			
31	48	Shale-Grey			
48	62	Sandstone-Grey-Shale-Grey			
62	88	Shale-Grey			
88	98	Limestone-Grey			
98	100	Shale-Grey			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 5-12-95 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 182 This Water Well Record was completed on (mo/day/yr) 5-25-95 under the business name of STRADER DRILLING CO., INC. by (signature) Dale Strader

INSTRUCTIONS: Use typewriter or ball point pen. *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

OFFICE USE ONLY T R E/W SEC. ¼ ¼ ¼

Table 2-1. North Landfill Well Construction and Water Level Data

WELL ID	SCREENED FORMATION	TOTAL BOREHOLE DEPTH	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	SCREENED DEPTH INTERVAL	ELEVATION OF TOP OF SCREEN	ELEVATION OF BOTTOM OF SCREEN	June 2010	June 2010 Water Elevations	SEPTEMBER 2010	September 2010 Water Elevations
North Landfill		(feet)	(MSL)	(MSL)	(ft BGS)	(MSL)	(MSL)	(ft BTOC)	(MSL)	(ft BTOC)	(MSL)
NLF-OW-05	Topeka Limestone	26.00	1010.05	1012.26	10.0-25.0	1000.05	985.05	NS	NS	12.44	999.82
NLF-OW-05D	Calhoun Shale	57.40	1010.85	1013.31	35.0-45.0	975.85	965.85	NS	NS	NS	NS
NLF-OW-06	Topeka Limestone	33.90	1027.05	1029.49	19.0-29.0	1008.05	998.05	14.70	1014.79	14.60	1014.89
NLF-OW-06D	Calhoun Shale	54.00	1026.58	1028.75	42.0-52.0	984.58	974.58	NS	NS	NS	NS
NLF-OW-07	Quarternary	21.60	1034.59	1037.02	11.0-21.0	1023.59	1013.59	NS	NS	12.03	1024.99
NLF-OW-07D	Calhoun Shale	64.00	1034.55	1036.78	53.5-63.5	981.05	971.05	NS	NS	NS	NS
NLF-OW-08	Topeka Limestone	46.80	1031.40	1033.77	24.8-34.8	1006.60	996.60	NS	NS	25.95	1007.82
NLF-OW-10	Topeka Limestone	35.90	1011.25	1014.37	18.0-28.0	993.25	983.25	NS	NS	15.30	999.07
NLF-OW-11D	Calhoun Shale	56.80	1020.76	1023.03	29.5-39.5	991.26	981.26	NS	NS	NS	NS
NLF-OW-12	Topeka Limestone	57.50	1040.41	1042.57	27.88-37.88	1012.53	1002.53	NS	NS	13.74	1028.83
NLF-OW-13	Topeka Limestone	57.00	1029.57	1031.72	29.5-39.6	1000.07	990.07	NS	NS	28.17	1003.55
NLF-OW-14	Topeka Limestone	36.00	1031.60	1033.86	25.5-35.5	1006.10	996.10	11.87	1021.99	13.69	1020.17
NLF-OW-14D	Calhoun Shale	60.00	1031.53	1033.79	49.5-59.5	982.03	972.03	NS	NS	NS	NS
OW-MSR-01	Calhoun Shale	45.00	1021.47	1021.20	34.5-44.5	986.97	976.97	20.66	1000.54	22.86	998.34
OW-MSR-02	Cahoun Shale	54.00	NA	1023.23	42.83-52.83	-	-	NS	NS	NS	NS
OW-MSR-03	Calhoun Shale	56.60	NA	1028.56	44.98-54.98	-	-	27.97	1000.59	30.10	998.46
OW-MSR-04	Topeka Limestone	35.00	1030.13	1029.84	23.0-33.00	1007.13	997.13	16.62	1013.22	13.99	1015.85
OW-MSR-05	Topeka Limestone	35.00	1022.05	1021.66	15.00-25.00	1007.05	997.05	10.49	1011.17	13.17	1008.49
OW-MSR-06	Topeka Limestone	15.00	1015.69	1015.55	9.0-14.0	1006.69	1001.69	4.76	1010.79	8.04	1007.51
OW-MSR-07	Topeka Limestone	21.00	1019.57	1019.39	10.0-20.0	1009.57	999.57	6.44	1012.95	7.39	1012.00
OW-MSR-08	Topeka Limestone	33.50	1029.00	1028.80	23.0-33.0	1006.00	996.00	11.48	1017.32	10.22	1018.58
OW-MSR-09	Topeka Limestone	13.00	1013.91	1013.91	7.0-12.0	1006.91	1001.91	2.92	1010.99	4.49	1009.42

Notes:
MSL - Mean Sea Level
ft BGS - Feet below ground surface
ft BTOC - Feet below top of casing
OW - Observation Well
NA - Not available (Wells installed for 2004 RI Addendum Report, but report did not list these records)
NS - Not Measured
All OW-MSR Wells are flushmount wells

Table 2-2: South Landfill Well Construction

WELL ID	SCREENED FORMATION	TOTAL BOREHOLE DEPTH	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	SCREENED DEPTH INTERVAL	ELEVATION OF TOP OF SCREEN	ELEVATION OF BOTTOM OF SCREEN	June 2008	June 2008 Water Elevations
South Landfill		(feet)	(MSL)	(MSL)	(ft BGS)	(MSL)	(MSL)	(ft BTOC)	(MSL)
SLF-OW-01	Severy Shale	22.00	1005.29	1007.73	10.0-20.0	995.29	985.29	14.16	993.57
SLF-OW-02	Topeka Limestone	24.80	1002.19	1004.67	9.0-14.0	993.19	988.19	11.76	992.91
SLF-OW-03	Severy Shale	22.40	1020.53	1022.75	11.0-21.0	1009.53	999.53	12.93	1009.82
SLF-OW-04	Severy Shale	14.00	1017.63	1020.04	5.5-10.5	1012.13	1007.13	NS	NS
SLF-PZ-04	Severy Shale	28.80	1017.84	1020.29	15.9-25.9	1001.94	991.94	8.21	1012.08
SLF-OW-15	Topeka Limestone	14.30	1007.71	1009.86	8.4-13.4	999.31	994.31	12.86	997.00
SLF-OW-17	Topeka Limestone	26.50	NA	1003.26	10.82-15.82	-	-	14.23	989.03
SLF-OW-18	Severy Shale	39.00	NA	990.49	1.82-11.82	-	-	9.00	981.49

Notes:
MSL - Mean Sea Level
ft BGS -Feet below ground surface
ft BTOC - Feet below top of casing
OW - Observation Well
NA - Not available (Wells installed for 2004 RI Addendum Report, but report did not list these records)
NS - Not Measured